In general -- “Level of protection”

- *what* is to be protected (e.g., which fish species)
- *from what effects* they are to be protected (e.g., reproductive effects from Se), and
- *how much* protection is desired. E.g.,
  - is every individual member of the species is to be protected from harm, or is the species is to be protected from population-level effects, or both
  - how much confidence that protection will be achieved is necessary (i.e., how to address uncertainty)

In practice – "level of protection" for aquatic life from reproductive effects caused by Se

- Se guidelines for aquatic life are now commonly specified in terms of a tissue (or egg-ovary) concentration
  - Effect of concern is reproductive
- The tissue concentration guidelines reflect both *what* is to be protected and *how much* protection is desired
  - Based on Se toxicity studies and policy judgments about how much protection should be provided.
  - E.g., In the USEPA guideline document, species-specific egg or ovary concentrations are identified based on an EC10 value, for all species where those studies have been done
    - If only one of those species were identified as the species to be protected, a guideline might be based on those values alone
- The tissue concentration guideline is translated to a water-column guideline
  - via a validated ecosystem-scale model of Se that conceptualizes and quantifies partitioning/bioaccumulation from water, through particulate, through the food web to those species of interest

Complications

- How to determine a protective guideline for fish species for which toxicology data are not available?
  - USEPA and BCMOE both take a “conservative approach” and assume some species more sensitive than the most sensitive *tested* species exist
  - The agencies apply different approaches to defining “conservative,” resulting in different guidelines
- How should differences in species-specific bioaccumulation and toxicology be treated in translation of tissue guidelines to a water-column guideline
  - If toxicology were understood for every species in the reservoir, a single water-column guideline (or perhaps a set of location-specific water column guidelines) is still required

In implementation (out of scope)

- How do we measure compliance with a guideline?
- In implementation guidance, agencies may include considerations related to
  - measurement challenges,
  - data outliers, and
  - the level of confidence that a small sample provides about the population of the species being evaluated/protected.
- For example, an implementation guideline might specify a minimum sample size, and the mean, variance, etc of the sample that would demonstrate compliance (the BC guideline is a partial example of this)

These important questions are outside the scope of the modeling efforts and should be considered separately in implementation after a guideline has been chosen.

How the alternatives under discussion reflect "levels of protection"

- Alternatives 1-4 embody the following answers to the various level of protection questions:
  - The effect of concern is reproductive (so an egg-ovary guideline is specified).
  - A conservative assumption is made that the egg-ovary guideline should protect a species of unknown sensitivity based on the toxicology of known, sensitive species. Then two viewpoints on how to characterize that "most sensitive" species are considered:
    - the USEPA guideline of 15.1 mg/kg dw was designed to protective of 95% of all species based on EC10 toxicology studies of some species
    - the BC MOE guideline value of 11 mg/kg dw was set to half the EC10 level for trout.
  - Both consideration of effects on individuals and effects on populations are considered (separately in the different alternatives)
- Alternative 5 differs from the first four, and the rationale is not as clear. Based on discussions at our last call,
  - The "effect" of concern is the potential for a health advisory for high levels of fish consumption (so a tissue guideline is specified)
  - A conservative view is taken and a tissue guideline about half the level that would trigger a health advisory in BC is proposed.
  - A population value is proposed, consistent with a consumption-based effect of concern.